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Original Article

Prevalence and risk factors of erosive esophagitis in Taiwan

Jian-Lin Ou [a,b], Chin-Chih Tu [a,c,*], Ping-I Hsu [a], Min-Hsiung Pan [c], Chung-Cheng Lee [b], Feng-Woei Tsay [a], Huay-Min Wang [a], Lung-Chih Cheng [d], Kwok-Hung Lai [a], Hsien-Chung Yu [a]

[a] *Division of Gastroenterology, Department of Medicine, Kaohsiung Veterans General Hospital, Kaohsiung, Taiwan, ROC*
[b] *Division of Gastroenterology, Department of Medicine, Zuoying, Armed Forces General Hospital, Kaohsiung, Taiwan, ROC*
[c] *National Kaohsiung Marine University, Kaohsiung, Taiwan, ROC*
[d] *Division of Gastroenterology, Department of Medicine, Tao-Chien Hospital, Taiwan, ROC*

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Abstract

Background: Erosive esophagitis is a common condition in the western population. However, the prevalence and risk factors of this disorder in Taiwan remain unclear. This study investigated the current prevalence of erosive esophagitis in Taiwan and attempted to identify the risk factors for this disease.
Methods: From January 2008 to May 2009, 2040 consecutive subjects who underwent upper gastrointestinal endoscopy during their annual health check-up were enrolled. The severity of erosive esophagitis was evaluated according to the Los Angeles classification, and the independent risk factors of erosive esophagitis were analyzed using the logistic regression method.
Results: The prevalence of erosive esophagitis was 17.3% (352/2040), with 71.6%, 27.8%, 0.5% and 0% cases of grades A, B, C and D, respectively, according to the Los Angeles classification. Univariate analysis revealed that male sex, smoking, alcohol consumption, betel nut chewing habit, body mass index ≥ 27 kg/m^2, hypertension, use of calcium channel blockers, diabetes, hyperglycemia, hypertriglyceridemia, and hiatus hernia were associated with the development of erosive esophagitis. Multivariate analysis revealed that male sex [odds ratio (OR) = 2.013, 95% confidence interval (CI) = 1.439–2.815; $p < 0.001$), smoking (OR = 1.301, 95% CI = 1.089–1.555; $p = 0.004$), body mass index > 27 (OR = 1.348, 95% CI = 1.138–1.598; $p = 0.001$), and hiatus hernia (OR = 4.331, 95% CI = 3.304–5.784; $p < 0.001$) were independent risk factors for the development of erosive esophagitis.
Conclusion: The current prevalence of erosive esophagitis in Taiwan is 17.3%. Male sex, smoking, obesity, and hiatus hernia are four independent risk factors for the development of erosive esophagitis in the Taiwanese population.
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Keywords: body mass index; erosive esophagitis; gastroesophageal reflux disease; hiatus hernia

1. Introduction

Gastroesophageal reflux disease (GERD) is a common disorder in the western population, with a prevalence ranging from 14% to 31% for weekly reflux symptoms.[1–9] The prevalence of GERD is considerably low in the Chinese population, in which symptoms of heartburn or acid regurgitation occur monthly or more frequently in 9.3% of subjects, according to a population survey.[10]

GERD can be subdivided into erosive esophagitis and endoscopy-negative reflux disease (or nonerosive reflux disease). Patients with nonerosive reflux disease have no mucosal breaks in the esophagus but have typical reflux symptoms. In contrast, patients with erosive esophagitis have mucosal breaks in the lower esophagus, as seen by endoscopy.[11] The prevalence of erosive esophagitis among dyspeptic patients has increased in recent decades in Taiwan, as revealed by comparing the data published in 1991 to those published in 1978.[12–14] According to a report published in

* Corresponding author. Dr. Chin-Chih Tu, Division of Gastroenterology, Department of Internal Medicine, Kaohsiung Veterans General Hospital, 386, Ta-Chung 1st Road, Kaohsiung 813, Taiwan, ROC.
E-mail address: williamhsup@yahoo.com.tw (C.-C. Tu).

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1995, the prevalence of erosive esophagitis in Taiwan was 5% in subjects who underwent a physical check-up. This prevalence was lower than that in western countries (10−20%).[15,16]

However, aging of the population, westernization of diet, and changes in lifestyles have been observed in the Taiwanese population in recent decades. It is reasonable to expect the prevalence of erosive esophagitis to be increasing now. Recently, a health screening program in a tertiary care center revealed 29% of subjects with manifestations suggesting GERD, including nonerosive reflux disease in 10.6%, symptomatic erosive esophagitis in 3.6%, and asymptomatic erosive esophagitis in 14.8%.[17] Additionally, another recent study has demonstrated the time trend for the increase in the prevalence of erosive esophagitis in Taiwan from 2000 (14.5%) to 2007 (23.5%).[18]

In addition to the prevalence of reflux esophagitis, risk factors of erosive esophagitis among the Taiwanese and Koreans have been reported.[19] However, only the clinical parameters for reflux esophagitis have been studied in the Asian population. Whether the biochemical risk factors are relevant to erosive esophagitis in the general population remains unclear.

The aims of this study were to investigate the current prevalence of erosive esophagitis in Taiwan, and to identify the clinical and biochemical risk factors for this disease.

2. Methods

2.1. Participants

From January 2008 to May 2009, 2040 consecutive subjects who underwent upper gastrointestinal endoscopy during their annual self-paid health check-ups at the Kaohsiung Veterans General Hospital, Taiwan were enrolled in this study. Exclusion criteria were age <18 years old, subjects' refusal to participate, and history of esophageal stricture and laryngeal stenosis. The study was approved by the hospital's human subjects committee.

2.2. Study design

Three experienced endoscopists (Hsu PI, Cheng LJ, and Yu SC) performed endoscopy using the Olympus GIF XV10 and GIF XQ200 (Olympus, Tokyo, Japan) systems after subjects had fasted overnight. The presence of esophageal mucosal breaks and hiatus hernia were carefully examined, and the length of the breaks was measured by opening a pair of biopsy forceps of known size in front of the breaks. The severity of esophagitis was classified according to the Los Angeles (LA) classification (grades A−D),[20] which is based on the length and confluence of mucosal breaks.

To assess the association between clinical characteristics and asymptomatic esophagitis, the following data were recorded for each subject with a standardized questionnaire: age; sex; smoking habit; alcohol, tea and coffee consumption; betel nut chewing habit; history of hypertension and antihypertensive drugs; diabetes; and chronic obstructive pulmonary disease (COPD). The body mass index (BMI) was calculated using the following formula: BMI = weight (kg)/(height)^2 (m^2). The Department of Health (DOH) in Taiwan defines overweight individuals as those with a BMI $\geq$ 24 and obese individuals as those with a BMI $\geq$ 27; the subjects in our study were classified as thin, normal, overweight, and obese according to BMI. In addition, venous blood was drawn before endoscopy for determination of blood sugar, triglyceride, total cholesterol, low-density lipoprotein (LDL), and high-density lipoprotein (HDL) levels. All variables were categorized for data analyses.

2.3. Endoscopic findings

The LA classification was used to evaluate the severity of erosive esophagitis. The criteria for the diagnosis of esophagitis were as follows: grade A, one or more mucosal breaks confined to the mucosal folds, each no longer than 5 mm; grade B, at least one mucosal break longer than 5 mm and confined to the mucosal folds; grade C, at least one mucosal break continuing between the tops of two or more mucosal folds but not circumferential; and grade D, circumferential mucosal break.

2.4. Statistical analysis

The χ^2 test or Fisher's exact test was performed to investigate the relationships between the rate of erosive esophagitis and clinical characteristics. The following variables were included: sex; age (< 45, 45−60, or > 60 years); smoking history (yes or no); history of alcohol consumption (none, $\leq$3 times per week, or > 3 times per week); consumption of coffee (yes or no) and tea (yes or no); betel nut chewing (no, $\leq$3 times per week, or > 3 times per week); history of diabetes medication (yes or no); history of hypertension (yes or no); use of calcium channel blockers (yes or no); use of isosorbide dinitrate (yes or no); history of COPD (yes or no); BMI (< 18.5, 18.5−24, 24−27, or > 27); hiatus hernia (yes or no); fasting sugar levels ($\leq$ 110 mg/mL or > 110 mg/mL); serum triglyceride levels (<150 mg/dL or $\geq$ 150 mg/dL); serum total cholesterol levels ($\leq$ 240 mg/mL or > 240 mg/mL); serum HDL cholesterol levels in male subjects (<40 mg/dL or $\geq$ 40 mg/dL); serum HDL cholesterol levels in female subjects (<50 mg/dL or $\geq$ 50 mg/dL); and serum LDL levels (<160 mg/dL or $\geq$ 160 mg/dL). A p value <0.05 was considered significant. Those variables found to be significant by univariate analysis were subsequently assessed by a stepwise logistic regression method to identify independent clinical and biochemical factors predicting the presence of reflux esophagitis.

3. Results

3.1. Prevalence of erosive esophagitis

A total of 2040 subjects (mean age, 51.4 $\pm$ 12.19 years; male/female, 1195/845) who underwent a medical check-up at Kaohsiung Veterans General Hospital, Taiwan were recruited

for the study. Of these patients, 352 (17.3%) had erosive esophagitis (Table 1). The prevalence of erosive esophagitis in male and female subjects was 23.8% and 7.9%, respectively. The distribution of the esophagitis cases according to the LA classification was as follows: grade A, 71.6%; grade B, 27.8%; grade C, 0.5%; and Grade D, 0%.

3.2. Independent clinical and biochemical factors predicting development of erosive esophagitis

Table 2 shows the associations between clinical and biochemical characteristics and the presence of erosive esophagitis. The incidence of erosive esophagitis was higher in male than in female subjects. Additionally, history of smoking, alcohol consumption, betel nut chewing habit, history of diabetes, history of hypertension, use of calcium channel blockers, BMI $\geq$ 27 kg/m^2, hiatus hernia, hyperglycemia (fasting sugar $\geq$ 110 mg/dL), and hypertriglyceridemia (triglyceride $\geq$ 150 mg/dL) were significantly associated with erosive esophagitis ($p < 0.001$, $p < 0.001$, $p < 0.001$, $p < 0.001$, $p = 0.019$, $p = 0.002$, $p = 0.023$, $p < 0.001$, $p < 0.001$, and $p < 0.001$, respectively). However, age, coffee and tea consumption, COPD, total cholesterol, HDL cholesterol, and LDL cholesterol were not significantly associated with erosive esophagitis.

Multivariate analysis with stepwise logistic regression showed that only male sex [odds ratio (OR) = 2.013, 95% confidence interval (CI) = 1.439–2.815; $p < 0.001$], smoking (OR = 1.301, 95% CI = 1.089–1.555; $p = 0.004$), BMI > 27 (OR = 1.348, 95% CI = 1.138–1.598; $p = 0.001$), and hiatus hernia (OR = 4.331, 95% CI = 3.304–5.785; $p < 0.001$) were independent risk factors for the development of erosive esophagitis (Table 3).

Table 1
Demographic data of the studied subjects (n = 2040).

Clinical characteristics	
Age Mean (SD) y	51.41 (12.19)
<45 y	587 (28.77%)
45–60 y	950 (46.56%)
>60 y	503 (24.65%)
Sex	
Male	1195 (58.57%)
Female	845 (41.42%)
BMI	
Mean (SD), kg/m^2	23.932 (3.5992)
<18.5	87 (4.28%)
18.5 $\leq$ BMI < 24.0	1004 (49.40%)
24.0 $\leq$ BMI < 27.0	577 (28.39%)
>27.0	364 (17.91%)
Endoscopic finding	
Reflux esophagitis	352/2040
Grade A	252 (71.59%)
Grade B	98 (27.84%)
Grade C	2 (0.56%)
Grade D	0 (0.0)

BMI = body mass index; SD = standard deviation.

Table 2
Univariate analysis of clinical and biochemical factors associated with development of erosive esophagitis.

Principal parameter	No. of subjects	Erosive esophagitis	p
Sex			
Male	1195	285 (23.8%)	<0.001
Female	845	67 (7.9%)	
Age (y)			
<45	587	106 (18.1%)	0.818
45 $\leq$ age < 60	950	162 (17.1%)	
$\geq$60	503	84 (16.7%)	
Smoking status			
No	1443	198 (13.7%)	<0.001
Yes	487	130 (26.7%)	
Alcohol drinking			
No	898	124 (13.8%)	<0.001
$\leq$3 times per week	869	157 (18.1%)	
>3 times per week	174	46 (26.4%)	
Coffee drinking			
No	400	64 (16.0%)	0.445
Yes	348	63 (18.1%)	
Tea drinking			
No	278	42 (15.1%)	0.295
Yes	470	85 (18.1%)	
Betel nut chewing habit			
No	1801	282 (15.7%)	<0.001
$\leq$3 times per week	123	39 (31.7%)	
>3 times per week	22	8 (36.4%)	
Diabetes			
No	1903	318 (16.7%)	0.019
Yes	134	33 (24.6%)	
Hypertension			
No	1682	270 (16.1%)	0.002
Yes	355	81 (22.8%)	
Use of calcium channel blockers			
No	1998	339 (17.0%)	0.023
Yes	42	13 (31.0%)	
Use of isosorbide dinitrate			
No	2037	352 (17.3%)	1
Yes	3	0 (0%)	
COPD			
No	1968	340 (17.3%)	0.773
Yes	69	11 (15.9%)	
BMI			
<18.5	87	8 (9.2%)	<0.001
18.5 $\leq$ BMI < 24.0	1004	120 (12.0%)	
24.0 $\leq$ BMI < 27.0	577	126 (21.8%)	
>27	364	96 (26.4%)	
Hiatus hernia			
No	1601	203 (12.7%)	<0.001
Yes	366	149 (42.3%)	
Fasting sugar			
<110 mg/dL	1792	292 (16.3%)	0.002
$\geq$110 mg/dL	248	60 (24.2%)	
Serum triglyceride			
<150 mg/dL	1459	208 (14.3%)	<0.001
$\geq$150 mg/dL	541	133 (24.6%)	
Serum total cholesterol			
<240 mg/dL	1787	312 (17.5%)	0.516
$\geq$240 mg/dL	253	40 (15.8%)	

Table 2 (*continued*)

Principal parameter	No. of subjects	Erosive esophagitis	*p*
Serum HDL cholesterol			
male < 40 mg/dL	494	122 (24.7%)	0.573
≥40 mg/dL	700	163 (23.3%)	
Serum HDL cholesterol			
female < 50 mg/dL	349	28 (8.0%)	0.939
≥50 mg/dL	495	39 (7.9%)	
Serum LDL cholesterol			
<160 mg/dL	1885	325 (17.2%)	0.927
≥160 mg/dL	154	27 (17.5%)	

BMI = body mass index; COPD = chronic obstructive pulmonary disease; HDL = high-density lipoprotein; LDL = low-density lipoprotein.

4. Discussion

GERD has been traditionally considered less common in Asia, especially in East Asia, where a prevalence as low as 2.4% in the general population was reported in the 1970s.[13] The prevalence rate of erosive esophagitis in this study was found to be 17.3%, which was higher than that reported in two previous studies conducted in 1995 (5%) and 1999 (12%) in Taiwan. Additionally, the prevalence rate was also higher than that in Koreans (3.4%) and Japanese (7.1%) and comparable to that in Swedes (15.5%) with the same background as the subjects of this study. This finding indicates that the prevalence of erosive esophagitis has increased in Taiwan in recent decades.

The reasons for the increasing prevalence of erosive esophagitis remain unclear, but they are probably related to the changes in lifestyles, westernization of diet, lack of exercise, aging of the population, and a decrease in *Helicobacter pylori* infection. Improvement of diagnostic techniques such as endoscopy and increased medical attention to erosive esophagitis are other possible factors.

In this study, multivariate analysis revealed that male sex, smoking, obesity, and hiatus hernia were four independent risk factors for the development of erosive esophagitis, with ORs of 2.013, 1.301, 1.348, and 4.331, respectively. The association of erosive esophagitis with male sex and smoking in our study was consistent with another recent study showing that male sex, smoking, and metabolic syndrome independently increased the likelihood of progressing from a nonerosive to an erosive stage of disease and/or lowered the likelihood of disease regession.[21]

Table 3
Independent risk factors for development of erosive esophagitis in Taiwan.

Risk factors	Coefficient	Standard error	OR (95% CI)	*p*
Male gender	0.699	0.172	2.013 (1.439–2.815)	<0.001
Smoking	0.263	0.091	1.301 (1.089–1.555)	0.004
BMI > 27 kg/m^2	0.299	0.087	1.348 (1.138–1.598)	0.001
Hiatal hernia	1.475	0.143	4.331 (3.304–5.784)	< 0.001

BMI = body mass index; CI = confidence interval; OR = odds ratio.

Although hyperglycemia (fasting sugar ≥ 110 mg/dL) and hypertriglyceridemia (triglycerides ≥ 150 mg/dL) were two biochemical factors related to the development of erosive esophagitis, the two factors were excluded as independent factors following logistic regression.

In the current study, hiatus hernia was the most important factor related to the development of erosive esophagitis. This finding is supported by other studies.[19,22–24] It is believed that the crural diaphragm is important in the prevention of gastroesophageal reflux during periods of low lower esophageal sphincter (LES) pressure.[25] Hiatus hernia results in malfunction of the gastroesophageal barrier. People with hiatus hernia have more reflux episodes during lower LES pressure, swallow-associated normal LES relaxation, deep inspiration, and strain in the presence of GERD. Hiatus hernia increases esophageal acid exposure because it impairs the LES, reduces LES pressure and length, and alters the opening characteristics of the gastroesophageal junction.[26]

Male sex was also identified as an independent risk factor for erosive esophagitis in the present study. Several previous studies also have shown that male sex is a risk factor for reflux esophagitis.[27] However, a population-based study in the United States failed to show any differences between male and female subjects with respect to the prevalence of reflux symptoms.[28] Thus far, the reason for the higher frequency of asymptomatic erosive esophagitis in male subjects is unclear. However, lower parietal cell mass and better living habits in women may be two of the factors leading to the lower risk of erosive esophagitis.

The overall prevalence of obesity in Taiwan was 19.2% and 13.4% in men and women, respectively. Obesity has been identified as an independent risk factor in several previous reports.[29] In this study, we found a strong positive association between obesity and erosive esophagitis. These associations remained robust even after adjustments for several important potential confounding factors, including age, sex, and lifestyles. However, a previous study in Taiwan failed to identify obesity as a risk factor for the development of erosive esophagitis.[19] The mechanism by which obesity increases the risk of erosive esophagitis is unknown. The possible explanations include the development of hiatus hernia, increased intra-abdominal pressure, increased frequency of transient LES relaxation,[30] and high acid secretion rates. Moreover, the upper gastrointestinal tract of obese subjects seems to be more sensitive to acid.

In the present study, smoking was also found to be a risk factor for the development of erosive esophagitis in Taiwan. Several experimental studies have revealed a reduction in LES pressure and frequent reflux episodes during smoking.[31] Additionally, a previous study showed that GERD symptoms were related to the total amount of smoking.[32]

In the present study, most erosive esophagitis cases were of mild to moderate severity; this finding was similar to those in studies from other Asian countries and Scandinavia.[16,33,34]

It is important to note that 26.4% of the subjects did not have any symptoms, such as acid regurgitation and heartburn. Currently, the natural history of asymptomatic esophagitis

remains unclear[35] and merits further study to investigate the necessity of medical therapy.

In conclusion, the current prevalence of erosive esophagitis in Taiwan is 17.3%. Male sex, smoking, obesity, and hiatus hernia are four independent risk factors for the development of erosive esophagitis in the Taiwanese. Adequate weight control and abstinence from smoking may be important steps for the prevention of erosive esophagitis in Taiwan.

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